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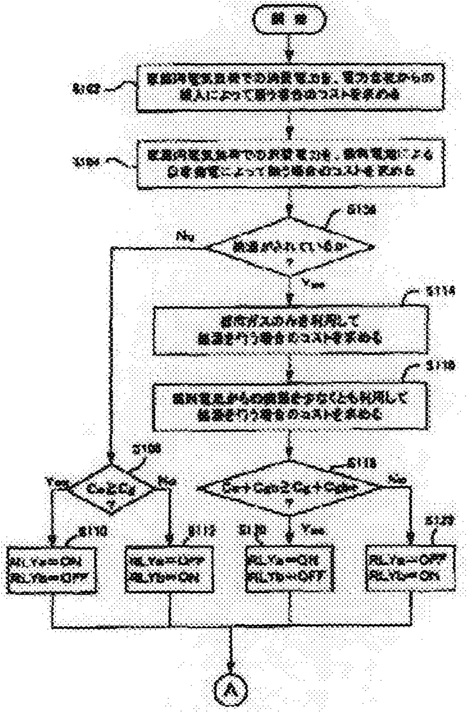
(54) FUEL CELL SYSTEM AND SWITCHING METHOD OF POWER SUPPLY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a fuel cell system that can optimally restrain total running cost.
SOLUTION: A control 600 determines cost Ce, when consumption power in a domestic electrical load 400 is obtained by purchasing from a power company (S102), and finds a cost Cg, when the power is obtained by non-utility generation using a fuel cell 200 (S104). When hot water is supplied (S106), control further finds a cost Cgb incurred, when hot water is supplied to the hot-water supply target 500 using only city gas (S114), and determines cost Cgbc incurred, when hot water is supplied using at least waste heat from the fuel cell 200 (S116). When the cost of Cg+Cgbc is lower than that of Ce+Cgb, the control 600 supplies the power from the fuel cell 200 to the domestic electrical load 400 (S120). When the cost of Ce+Cgb is lower than that of Cg+Cgbc, the power from the power company is supplied to the domestic electrical load 400 (S122).



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the fuel cell system which can supply at least one side to electric load among the electric power generated from the fuel cell device, and the electric power introduced from the outside.

[0002]

[Description of the Prior Art]Utility value is examined also as a small non-portable power generation system which uses at home etc. the fuel cell system which was eco-friendlily excellent in energy saving. For example, at home, since the heat generated at the time of power generation of a fuel cell can be used for hot water supply, such as a bath, the cogeneration effect can attain still higher energy efficiency.

[0003]What is proposed now as a fuel cell system used at such a home etc., for example, commercial gas, such as town gas, to a reformer -- hydrogen -- it is a system which generates rich fuel gas, supplies this fuel gas and oxidizing gas, such as air, to a fuel cell, and is generated according to electrochemical reaction. And since the voltage obtained by this power generation is a direct current, it is changed into exchange by DC-AC inverter and used for household electric loads, such as an air-conditioner and a light.

[0004]By connecting the outside line from an electric power company between above-mentioned DC-AC inverter and household electric load, the insufficiency of the home-generation-of-electricity energy by a fuel cell is purchased from an electric power company via this outside line, and it also becomes possible to sell a part for an excess to an electric power company via this outside line.

[0005]

[Problem(s) to be Solved by the Invention]When using such a fuel cell system, the cost at the time of carrying out a home generation of electricity (mainly gas rate) yields running profits from an electric power company with a fuel cell, in being cheap compared with the cost at the time of purchasing electric power (electricity bill). However, when since the cost at the time of carrying out a home generation of electricity is cheap is said, it generates electricity too much superfluously and the selling price in that case is cheaper than the gas bill required to generate a part for the excess since a part for an excess will be sold to an electric power company, running profit and loss will be yielded. Therefore, it is more desirable on a cost merit to lessen a part for such an excess as much as possible. The quantity nearest to the electric power consumed with household electric load in short is generated with a fuel cell, and it is to the foundations of system operation to provide transitional part for the insufficiency of electric power or an excess by the purchase from an electric power company or sale to an electric power company.

[0006]However, it is predicted that ** rivals the gas rate at the time of use of the fuel cell system in such [in the future] a near home etc. taking for expanding, and carrying out a home generation of electricity with a fuel cell and the electricity bill at the time of purchasing electric power from an electric power company. In such a case, switching the home generation of electricity by a fuel cell and the purchase of the electric power from an electric power company every moment, and performing them will hold down a total running cost. However, it becomes SUBJECT concretely how it switches.

[0007]Therefore, the purpose of this invention solves SUBJECT of the above-mentioned conventional technology, and there is in providing the fuel cell system which can hold down a total running cost the optimal.

[0008]

[The means for solving a technical problem, and its operation and effect] In order to attain at least a part of above-mentioned purpose, the 1st fuel cell system of this invention, The inside of the electric power which was provided with the fuel cell device which generates electric power in response to supply of fuel, and was generated from this fuel cell device, and the electric power introduced from the outside, The changeover section which is a fuel cell system which can supply at least one side to electric load, switches the electric power from said fuel cell device, and the electric power from the outside, and supplies at least one side to said electric load among both, The cost of said fuel applied when providing the electric power which should be supplied to said electric load with the electric power from said fuel cell device, The cost of said electric power built when providing the electric power which should be supplied to said electric load with the electric power from the outside is computed, and based on the these-computed cost, let it be a gist to have a control section which controls the change of the electric power in said changeover section so that total cost may become cheap.

[0009]The 1st power supply change method of this invention is provided with the fuel cell device which generates electric power in response to supply of fuel, The inside of the electric power generated from this fuel cell device, and the electric power introduced from the outside, It is the change method of the power supply in the fuel cell system which can supply at least one side to electric load, (a) The cost of said fuel applied when providing the electric power which should be supplied to said electric load with the electric power from said fuel cell device, Based on the process of computing the cost of said electric power built when providing the electric power which should be supplied to said electric load with the electric power from the outside, and the (b)-these-computed cost, so that total cost may become cheap, Let it be a gist to switch the electric power from said fuel cell device, and the electric power from the outside, and to have the process of supplying at least one side to said electric load among both.

[0010]Thus, in the 1st fuel cell system or power supply change method. First, cost of fuel applied when providing electric power which should be supplied to electric load with electric power from a fuel cell device, He switches electric power from a fuel cell device, and electric power from the outside, and is trying to supply at least one side to electric load among both based on cost which computed cost of electric power built when providing meals with electric power from the outside, next was computed, so that total cost may become cheap.

[0011]Therefore, since according to the 1st fuel cell system or power supply change method a supply source of electric power can be chosen so that total cost may become cheaper every moment, it becomes possible to hold down a total running cost the optimal. Since a change of such electric power is performed automatically, without caring about a change, the user can use electric power and can realize work saving.

[0012]The 2nd fuel cell system of this invention generates electric power in response to supply of fuel, and. It is possible to supply at least one side to electric load among electric power which was provided with a fuel cell device which discards heat produced at the time of electric power generating, and was generated from this fuel cell device, and electric power introduced from the outside, and. A changeover section which is a fuel cell system which can give waste heat from said fuel cell to heat load, switches electric power from said fuel cell device, and electric power from the outside, and supplies at least one side to said electric load among both, Cost of said fuel applied when providing electric power which should be supplied to said electric load with electric power from said fuel cell device, Cost of said electric power built when providing electric power which should be supplied to said electric load with electric power from the outside, Cost of said fuel applied when covering heat which should be given to said heat load with heat acquired by burning said fuel, Compute cost of said fuel applied when covering heat which should be given to said heat load with waste heat from said fuel cell and providing the insufficiency with heat acquired by burning said fuel, respectively, and based on these-computed cost, so that total cost may become cheap, Let it be a gist to have a control section which controls a change of electric power in said changeover section.

[0013]The 2nd power supply change method of this invention generates electric power in response to supply of fuel, and. It is possible to supply at least one side to electric load among electric power which was provided with a fuel cell device which discards heat produced at the time of electric power generating, and was generated from this fuel cell device, and electric power introduced from the outside, and. It is the change method of power supply in a fuel cell system which can give waste heat from said fuel cell to heat load, (a) Cost of said fuel applied when providing electric power which should be supplied to said electric load with electric power from said fuel cell device, Cost of said electric power built when providing electric power which should be supplied to said electric load with electric power from the outside, Cost of said fuel applied when covering heat which should be given to said heat load with heat acquired by burning said fuel, Cost of said fuel applied when covering heat which should be given to said heat load with waste heat from said fuel cell and providing the insufficiency with heat acquired by burning said fuel, Based on a process each computed and (b)-these-computed cost, switch electric power from said fuel cell device, and electric power from the outside, and so that total cost may become cheap Both inside, Let it be a gist to have a process of supplying at least one side to said electric load.

[0014]Thus, in the 2nd fuel cell system or power supply change method. First, cost of fuel applied when providing electric power which should be supplied to electric load with electric power from a fuel cell device, Cost of fuel applied when covering cost of electric power built when providing meals with electric power from the outside, and heat which should be given to heat load with heat acquired by burning fuel, Cost of fuel applied when providing meals with waste heat from a fuel cell and providing the insufficiency with heat acquired by burning fuel, He switches electric power from a fuel cell device, and electric power from the outside, and is trying to supply at least one side to electric load among both based on cost which was each computed, next was these-computed, so that total cost may become cheap.

[0015]Therefore, also in the 2nd fuel cell system or power supply change method, since a supply source of electric power can be chosen so that total cost may become cheaper every moment, it becomes possible to hold down a total running cost the optimal. Since a change of such electric power is performed automatically, without caring about a change, the user can use electric power and can realize work saving. Since cogeneration is also positively taken into consideration, energy efficiency of the whole system can be raised, such as giving waste heat from a fuel cell to heat load.

[0016]In a fuel cell system of this invention, as for said control section, it is preferred to control a change of electric power in said changeover section so that only either may be supplied to said electric load among electric power from said fuel cell device, and electric power from the outside.

[0017]Thus, since the method of a change is simplified by controlling a change of electric power, a control method does not need to be complicated.

[0018]in a fuel cell system of this invention, said fuel cell device reforms said fuel -- hydrogen -- it is preferred to have a reformer which generates rich fuel gas, and a fuel cell which generates electric power in response to supply of said generated fuel gas.

[0019]Thus, power generation by a fuel cell can be performed as fuel by using a reformer using commercial gas etc.

[0020]In a fuel cell system of this invention, said changeover section, DC-AC inverter which changes into a volts alternating current direct current voltage outputted from said fuel cell device, The 1st power supply wire for supplying electric power to said electric load via said DC-AC inverter from said fuel cell device, The 2nd power supply wire for supplying electric power to said electric load from the exterior, The 1st switch that is arranged on said 1st power supply wire, and switches the energization/interception to this 1st power supply wire, It is arranged on said 2nd power supply wire, and has the 2nd switch that switches the energization/interception to this 2nd power supply wire, and, as for said control section, it is preferred to control said DC-AC inverter and said 1st and 2nd switches.

[0021]Output current from a fuel cell device is certainly controllable by controlling DC-AC inverter by constituting in this way, and electric power from a fuel cell device and electric power from the outside can be easily switched by controlling the 1st and 2nd switches.

[0022]In a fuel cell system of this invention, said fuel cell device, reforming said fuel -- hydrogen -- it has a reformer which generates rich fuel gas, and a fuel cell which generates electric power in response to supply of said generated fuel gas, and said changeover section, DC-AC inverter which changes into a volts alternating current direct current voltage outputted from said fuel cell device, The 1st power supply wire for supplying electric power to said electric load via said DC-AC inverter from said fuel cell device, The 2nd power supply wire for supplying electric power to said electric load from the exterior, The 1st switch that is arranged on said 1st power supply wire, and switches the energization/interception to this 1st power supply wire, It is arranged on said 2nd power supply wire, have the 2nd switch that switches the energization/interception to this 2nd power supply wire, and said control section, From quantity of said fuel gas supplied to said fuel cell, compute a target current value which should be outputted from said fuel cell, and said 1st switch from energization to interception. Or when switching to energization from interception, it is preferred to control said DC-AC inverter so that predetermined time in front of a change and current which is equivalent to said target current value from said fuel cell may be outputted.

[0023]When the 1st switch switches to interception from energization by controlling in this way, it can prevent fuel gas generated with a reformer flowing out into the atmosphere, without being consumed with a fuel cell, and decline in energy efficiency can be suppressed. It can bring close to a stationary state gradually, without producing a polarization reaction, since only a part to have been generated with a reformer consumes fuel gas the neither more nor less in a fuel cell and performs power generation operation, when the 1st switch switches to energization from interception.

[0024]

[Embodiment of the Invention]Hereafter, an embodiment of the invention is described in order of the following based on an example.

A. composition [of an example]: -- the function of B. each component, and : of operation -- control content:D. modification: by C. control section -- D-1. modification 1:D-2. modification 2:D-3. and other modification: [0025]A. Composition of an example : drawing 1 is a block diagram showing the composition of the fuel cell system as one example of this invention. The fuel cell system shown in drawing 1 is an usable fuel cell system at home etc., using as fuel the town gas which is commercial gas -- hydrogen from that town gas -- generating rich fuel gas, generating electricity using this generated fuel gas, and electric power being supplied to domestic electric load, and. The cogeneration effect has been acquired to hot water supply, such as a bath, using the heat generated on the occasion of power generation.

[0026]this fuel cell system -- mainly -- hydrogen from town gas and water -- with the reformer 100 which generates rich fuel gas. It has the control section 600 which comprises the inverters BOX300 and CPU etc. which switch fuel gas, the fuel cell 200 which generates electromotive force according to electrochemical reaction in response to supply of oxidizing gas, and the electric power from an electric power company and the electric power from the fuel cell 200. The fuel cell device 700 consists of the reformer 100 and the fuel cell 200.

[0027]The reformer 100 these in response to supply of town gas and water Among these, evaporation and the evaporator 102 which carries out temperature up, The combustion part 104 which generates the heat which the evaporator 102 takes, and the heat exchanger 106 which tells the heat generated in the combustion part 104 to the evaporator 102, It has the reforming section 108 which generates fuel gas by a reforming reaction, and the CO oxidizing part 110 which reduces the carbon monoxide (CO) concentration in the fuel gas generated by the reforming section 108 by oxidation reaction.

[0028]The fuel cell 200 is provided with the hydrogen pole 202 to which fuel gas is supplied, and the oxygen pole 204 to which oxidizing gas is supplied. DC-AC inverter 302 from which inverter BOX300 changes the direct current voltage from the fuel cell 200 into a volts alternating current, It has the relay switch A which switches energization/interception of the electric power from the fuel cell 200, and the relay switch B which switches energization/interception of the electric power from an electric power company.

[0029]In addition, the gas passageway 52 for supplying the town gas which is commercial gas, and the stream way 54 for supplying water from the exterior are connected to the evaporator 102. The flow control valve 58 and the flow rate sensor 60 are formed in the gas passageway 52, and the flow control valve 62 and the flow rate sensor 64 are formed in the stream way 54. The combustion fuel channel 56 for supplying combustion fuel is connected to the combustion part 104, and the flow control valve 66 is formed in the combustion fuel channel 56.

[0030]Blois 116,112,114 and 206 which compresses and supplies the air which is oxidizing gas is connected to the combustion part 104, the reforming section 108, the CO oxidizing part 110, and the fuel cell 200, respectively.

[0031]The output line from the fuel cell 200 and the outside line from an electric power company are connected to the input of inverter BOX300, and the output is connected to the household electric load 400 via the power sensor 402. As the household electric load 400, an air-conditioner, an electric fan-assisted heater, a refrigerator, a microwave oven, an electric rice-cooker, a washing machine, an electric drying machine, a light, a cleaner, etc. are mentioned.

[0032]In a home, the hot-water-supply objects 500 other than the household electric load 400, such as a bath and a floor heater, exist. For [this / 500] hot water supply, the hot water supply from the gas hot water supply device 504 and the hot water supply from the heat exchanger 502 are possible. The gas passageway 506 for supplying the town gas which is commercial gas is connected to the gas hot water supply device 504, and the cooling channel 208 drawn from the fuel cell 200 is connected to the heat exchanger 502.

[0033]B. The function and operation of each component : it is connected to the control section 600 by the control line which is not illustrated, respectively, and the flow control valve 58 and the flow control valve 62 adjust the amount of town gas supplied to the evaporator 102, and the quantity of water based on the control signal from the control section 600. It is connected to the control section 600 via the detection line which is not illustrated, respectively, and the flow rate sensor 60 and the flow rate sensor 64 detect the amount of town gas actually supplied to the evaporator 102, and the quantity of water, and transmit the detection result to the control section 600.

[0034]The evaporator 102 makes the water supplied via the stream way 54 evaporate, is mixed with the town gas supplied via the gas passageway 52, generates the original fuel gas which comprises town gas and a steam, carries out temperature up of this to a predetermined temperature, and supplies it to the reforming section 108.

[0035]The combustion part 104 which equipped the inside with the combustion catalyst is put side by side to the evaporator 102 considering town gas and water as evaporation and a heat source for carrying out temperature up. Combustion fuel is supplied via the combustion fuel channel 56, and the air which is oxidizing gas is supplied to this combustion part 104 by the blower 116 put side by side. It is connected to the control section 600 by the control line which is not illustrated, and the flow control valve 66 adjusts the quantity of the combustion fuel supplied to the combustion part 104 based on the control signal from the control section 600.

[0036]In the combustion part 104, if combustion fuel is supplied, a combustion reaction will advance on a catalyst using this fuel and air, and desired heat will be generated. The heat exchanger 106 is formed between the combustion part 104 and the evaporator 102, and the heat generated in the combustion part 104 by this heat exchanger 106 is told to the evaporator 102. The town gas which is commercial gas may be used as combustion fuel supplied to the combustion part 104, and the fuel off-gas discharged from the fuel cell 200 mentioned later may be used.

[0037]the reforming section 108 equipping the inside with the reforming catalyst, and reforming the original fuel gas which comprises the supplied town gas and a steam by a steam reforming reaction -- hydrogen --

rich fuel gas is generated and the CO oxidizing part 110 is supplied. The main ingredients of town gas are methane and can use a nickel catalyst as a reforming catalyst, for example. A steam reforming reaction occurs according to a formula (1).

[0038]

$CH_4+2H_2O \rightarrow 4H_2+CO_2$ (1)

[0039]thus -- the reforming section 108 -- a steam reforming reaction -- hydrogen, although rich fuel gas is generated, The air which is oxidizing gas is further supplied to the reforming section 108 by the blower 112 put side by side, and generation of hydrogen is made also by the partial oxidation reaction of town gas (methane). In this case, it becomes possible to cover the heat which a steam reforming reaction takes with the heat produced in partial oxidation reaction.

[0040]The CO oxidizing part 110 reduces the carbon monoxide concentration in the fuel gas generated by the reforming section 108, and supplies it to the fuel cell 200. It is because a catalyst will carry out poisoning and electrochemical reaction will be checked with the carbon monoxide in fuel gas, if the fuel gas generated by the reforming section 108 contains the carbon monoxide of the specified quantity and the fuel cell 200 is supplied as it is. The reaction which advances by the CO oxidizing part 110 is a carbon monoxide selective oxidation reaction which has priority over the hydrogen abundantly contained in fuel gas, and oxidizes carbon monoxide. For this reason, the air which is oxidizing gas is supplied to the CO oxidizing part 110 by Blois 114 put side by side, and. It fills up with the carrier which supported the platinum catalyst, ruthenium catalyst and palladium catalyst which are selective oxidation catalysts of carbon monoxide, the golden catalyst, or the alloy catalyst which made these the 1st element.

[0041]the fuel cell 200 -- hydrogen from the reformer 100 -- supply of rich fuel gas is received, and according to a reaction formula as shown below in the hydrogen pole 202 and the oxygen pole 204 in response to the air supply which is oxidizing gas by Blois 206 put side by side, electrochemical reaction is caused and electric power is generated.

[0042]namely, the hydrogen pole 202 -- hydrogen -- if the air whose rich fuel gas is oxidizing gas in the oxygen pole 204 is supplied, respectively, the reaction of a formula (2) will occur in the hydrogen pole side, the reaction of a formula (3) will occur in the oxygen pole side, respectively, and the reaction of a formula (4) will be performed as the whole fuel cell.

[0043]

$H_2 \rightarrow 2H^++2e^-$ (2)

$2H^++2e^-+(1/2)\ O_2 \rightarrow H_2O$ (3)

$H_2+(1/2)\ O_2 \rightarrow H_2O$ (4)

[0044]The fuel cell 200 has laminated stack structure, and two or more single cells one single cell, it comes out with an electrolyte membrane (not shown), the hydrogen pole 202 and the oxygen pole 204 which are diffusion electrodes which put it from both sides, and the separator (not shown) of two sheets which puts them from both sides further, and is constituted. Unevenness is formed in both sides of a separator and the gas passageway in a single cell is formed in them between the hydrogen pole 202 and the oxygen pole 204 which were put. Among these, oxidizing gas is flowing into the gas passageway in a single cell in which the fuel gas supplied to the gas passageway in a single cell formed between the hydrogen poles 202 as mentioned above is formed between the oxygen poles 204, respectively. And the fuel gas and oxidizing gas with which the above-mentioned electrochemical reaction was presented are discharged as off-gas. Every several layers, the cooling channel is formed between single cells and the heat produced in the above-mentioned electrochemical reaction etc. is removed by pouring cooling water in it.

[0045]The voltage used with the household electric load 400 to the voltage generated with the fuel cell 200 being direct current voltage is a volts alternating current. Therefore, DC-AC inverter 302 is formed between the fuel cell 200 and the household electric load 400, and the direct current voltage generated with the fuel cell 200 is changed into the volts alternating current by this.

[0046]The electric power inputted via DC-AC inverter 302 from the fuel cell 200 is supplied to the household electric load 400 via the relay switch A. Electric power other than the electric power from the fuel cell 200 is inputted via an electric power company to outside line, and this electric power is supplied to the household electric load 400 via the relay switch B. The relay switches A and B are connected to the control section 600 via the control line which is not illustrated, respectively, and ON/OFF is switched based on the control signal from the control section 600.

[0047]It is connected to the control section 600 via the detection line which is not illustrated, and the power sensor 402 formed between inverter BOX300 and the household electric load 400 detects the electric power consumed with the household electric load 400, and transmits the detection result to the control section 600.

[0048]On the other hand, the cooling water warmed via the cooling channel 208 from the fuel cell 200 is supplied to the heat exchanger 502. In the heat exchanger 502, the waste heat thrown away into the cooling water by the fuel cell 200 is collected, and hot water supply is performed to the hot-water-supply objects 500, such as a bath, using the collected heat.

[0049]Town gas is supplied to the gas hot water supply device 504 via the gas passageway 506, and hot water supply is performed to it to the hot-water-supply object 500 by burning the town gas.

[0050]CPU (not shown) which performs a predetermined operation etc. according to the control program with which the control section 600 was set up beforehand, ROM (not shown) in which a control program, control data, etc. required at CPU to perform various data processing were stored beforehand, Various data required similarly at CPU to carry out various data processing inputs RAM (not shown) written temporarily, the detection result from the various sensor of the flow rate sensors 60 and 64 and power sensor 402 grade, etc., and. It has input/output port etc. which output a control signal to controlled objects mentioned already according to the result of an operation in CPU, such as each blower and a flow control valve. The control section 600 controls the operational status of the whole fuel cell system by outputting and inputting various kinds of signals in this way.

[0051]As mentioned above, to the household electric load 400, the fuel cell system of this example can switch the electric power obtained by the home generation of electricity by the fuel cell 200, and the electric power produced by purchasing from an electric power company with the relay switches A and B, and can supply it now.To the hot-water-supply object 500, hot water supply is made using town gas, and also hot water supply has come be made using the waste heat from the fuel cell 200.

[0052]C. The control content by a control section : after the control section 600 also takes into consideration the cost concerning hot water supply besides the cost concerning an electric power supply, he is trying to switch the relay switches A and B in such a fuel cell system, in this example, so that total cost may become advantageous. When the control section 600 switches the relay switches A and B and one relay switch is turned on, the relay switch of another side is switched so that it may turn off.

[0053]Drawing 2 and drawing 3 are flow charts which show the control procedure of the control section 600 in the fuel cell system of drawing 1. Round A in drawing 2 follows round A in drawing 3.The control routine shown in drawing 2 and drawing 3 is repeated by the control section 600 for every fixed time.

[0054]A start of the control routine shown in drawing 2 will ask for the cost at the time of assuming that the control section 600 provides first the electric power consumed with the household electric load 400 by purchase from an electric power company in order to ask for the cost concerning the power consumption in a home (Step S102). Specifically, the following processings are performed.

[0055]Namely, the control section 600 inputs the detection result from the power sensor 402 first, Electric power:Uki [kW] consumed with the household electric load 400 is measured to every sampling time:DT (= 1 sec), and amount of used power:Xk [kWh] for the past 1 minute is computed by integrating with 60 samples according to a formula (5).

[0056]

Xk[kWh] =sigma(UkixDT) (5)

[0057]Next, the control section 600 computes cost:Ce [circle] in the case of covering the amount Xk of used power during this past minute [kWh] by purchase from an electric power company according to a formula (6).

[0058]

Ce [circle] =Ke1+Ke2xXk (6)

[0059]Ke1 is a constant equivalent to the basic charge of the electrical and electric equipment for the past 1 minute here, and Ke2 is a coefficient equivalent to an electric commodity charge unit price.

[0060]In this way, it can ask for the cost at the time of assuming that electric power is provided by purchase from an electric power company.

[0061]Next, it asks for the cost at the time of assuming that the control section 600 provides the electric power consumed with the household electric load 400 by the home generation of electricity by the fuel cell 200 (Step S104). Specifically, the following processings are performed.

[0062]That is, first, the control section 600 computes current:Ifc [A] which should be outputted from the fuel cell 200 according to a formula (7), in order to provide electric power:Uk [kW] consumed with the household electric load 400.

[0063]

Ifc[A] =KdcacxUk/Vfc (7)

[0064]Kdcac is a constant including the conversion efficiency of DC-AC inverter 302 in the inverter BOX300, etc. here, and Vfc[V] is voltage outputted from the fuel cell 200. This output voltage may be the value detected by the voltage sensor (not shown), and may be a constant on an approximate title.

[0065]Next, the control section 600 calculates hydrogen quantity:Fh [mol/s] required for making this computed current:Ifc [A] output from the fuel cell 200 based on the reaction formula (2) in the fuel cell 200 mentioned above. Specifically according to a formula (8), it computes.

[0066]

Fh [mol/s] (8) =IfcxKfch/(2xF)

[0067]Here, F is a Faraday constant and Kfch is a reciprocal of the hydrogen utilization in the fuel cell 200.

[0068]Next, the control section 600 calculates methane flux:Fm [mol/s] required for making this computed hydrogen quantity:Fh [mol/s] generate with the reformer 100 based on the reaction formula (1) in the reformer 100 mentioned above. Specifically according to a formula (9), it computes.

[0069]

Fm[mol/s]=Fh/4 (9)

[0070]Next, the control section 600 computes flow:Fk [mol/s] of the town gas which should be supplied to the reformer 100 according to a formula (10), in order to make this computed methane flux:Fm [mol/s] use it with the reformer 100.

[0071]

Fk[mol/s] =Km2 kxFm (10)

[0072]Generally natural gas is used for town gas, and nitrogen is mixed in it at a certain fixed rate. Therefore, in order to amend in consideration of this nitrogen content, in the formula (9), Km2k is hung as a coefficient.

[0073]In this way, to every sampling time:DT (= 1 sec), the control section 600 computes flow:Fki [mol/s] of the town gas which should be supplied to the reformer 100, according to a formula (11), is integrating with 60 samples and computes operating gas volume:Vk [m^3] for the past 1 minute.

[0074]

Vk[m^3] =Km2 vxsigma (FkixDT) (11)

[0075]Here, Km2v is a coefficient for changing the number of mols into the capacity of a normal condition (20 **, 1 atmosphere).

[0076]That is, the operating gas volume [it computed] Vk during this past minute [m^3] is the gas volume which is needed for covering the amount [it mentioned above] Xk of used power for the past 1 minute [kWh] by reforming town gas with the reformer 100 and performing a home generation of electricity with the fuel cell 200. Then, next, the control section 600 computes cost:Cg [circle] in the case of covering the amount Xk of used power for the past 1 minute [kWh] according to a formula (12) by performing the home generation of electricity by the fuel cell 200 using town gas from the operating gas volume [it computed] Vk during this past minute [m^3].

[0077]

Cg [circle] =Kg1+Kg2xVk (12)

[0078]Kg1 is a constant equivalent to the basic charge of the gas for the past 1 minute here, and Kg2 is a coefficient equivalent to the commodity charge unit price of gas.

[0079]In this way, it can ask for the cost at the time of assuming that electric power is provided by the home generation of electricity by a fuel cell.

[0080]Next, when it judges whether hot water supply is made the hot-water-supply objects 500, such as a bath (Step S106) and hot water supply is not carried out in the home now, the control section 600. Since it is necessary to take into consideration the cost concerning hot water supply when it progresses to processing of Step S108 and hot water supply is carried out, since it is not necessary to take into consideration the cost concerning hot water supply, it progresses to Step S114.

[0081]The cost (cost for the past 1 minute: Ce [circle]) at the time of assuming that the control section 600 is provided with Step S108 by purchase from an electric power company for which it asked at Step S102, The cost (cost for the past 1 minute: Cg [circle]) at the time of assuming that meals are provided by the home generation of electricity by the fuel cell 200 for which it asked at Step S104, Compare, and when the latter (home generation of electricity) cost Cg [circle] is cheaper than the former (purchase from an electric power company) cost Ce [circle], According to a formula (13), the relay flag RLYa corresponding to the relay switch A by the side of a fuel cell is turned ON, and the relay flag RLYb corresponding to the relay switch B by the side of outside line is turned OFF (Step S110).

[0082]

IF Ce>=Cg THEN RLYa=ON and RLYb=OFF (13)

[0083]On the contrary, when the former (purchase from an electric power company) cost Ce [circle] is cheaper than the latter (home generation of electricity) cost Cg [circle], According to a formula (14), the relay flag RLYa corresponding to the relay switch A by the side of a fuel cell is turned OFF, and the relay flag RLYb corresponding to the relay switch B by the side of outside line is turned ON (Step S112).

[0084]

IF Ce<Cg THEN RLYa=OFF,RLYb=ON (14)

[0085]However, at this time, the control section 600 does not switch the relay switches A and B.

[0086]The above is processing in case hot water supply is not carried out in the home. If this processing is completed, it will progress to the processing after round A of drawing 3 following round A of drawing 2.

[0087]On the other hand, when hot water supply is carried out in the home, the control section 600, In order to ask for the cost concerning the hot water supply in a home, it asks for the cost at the time of assuming that hot water supply is performed (only the gas hot water supply device 504 specifically performs hot water supply) by using only town gas first (Step S114). With thus, the case where hot water supply is performed only using town gas. It corresponds, when the fuel cell 200 does not perform a home generation of electricity and cannot use waste heat of the fuel cell 200 (i.e., when covering the power consumption in the household electric load 400 described above (when there is no cogeneration) by purchase from an electric power company). Specifically, the control section 600 performs the following processings.

[0088]The control section 600 acquires quantity-of-heat:Hb [kcal/s] required for hot water supply first, and computes flow:Fb [mol/s] of town gas required for the hot water supply in the case of providing this quantity-of-heat Hb [kcal/s] only by use of town gas according to a formula (15).

[0089]

Fb[mol/s] =Kh2 fxHb (15)

[0090]Here, Kh2f is a conversion factor which comprises the combustion heat of methane which is the main ingredients of town gas, the heat exchange effectiveness of the gas hot water supply device 504, etc.

[0091]Quantity-of-heat Hb [kcal/s] required for hot water supply is acquired based on the detection result from the temperature sensor which is not illustrated, the stored past data, etc.

[0092]In this way, to every sampling time:DT (= 1 sec), the control section 600 computes flow:Fbi [mol/s] of town gas required for hot water supply, according to a formula (16), is integrating with 60 samples and computes operating gas volume (only hot water supply):Vb [m^3] for the past 1 minute.

[0093]

Vb[m^3] =Km2 vxsigma (FbixDT) (16)

[0094]Here, Km2v is a coefficient for changing the number of mols into the capacity of a normal condition (20 **, 1 atmosphere) as it mentioned above.

[0095]Next, the control section 600 computed cost:Cgb in the case of performing hot water supply [circle] for the past 1 minute according to the formula (17) only using town gas from the operating gas volume [it computed] (only hot water supply) [m^3] Vb during this past minute.

[0096]

Cgb [circle] =Kg1+Kg2xVb (17)

[0097]Kg1 is a constant which is equivalent to the basic charge of the gas for the past 1 minute as mentioned above here, and Kg2 is a coefficient equivalent to the commodity charge unit price of gas.

[0098]In this way, it can ask for the cost at the time of assuming that hot water supply is performed by using only town gas.

[0099]Next, it asks for the cost at the time of assuming that the control section 600 performs hot water supply by using the waste heat from the fuel cell 200 at least (when there is cogeneration) (Step S116). With thus, the case where hot water supply is performed using the waste heat from the fuel cell 200. When it corresponds when covering the power consumption in the household electric load 400 by the home generation of electricity by the fuel cell 200, and hot water supply is performed only using the waste heat from the fuel cell 200 (only the heat exchanger 502 specifically performs hot water supply), The waste heat from the fuel cell 200 is used, and also it is divided, without the case where also use town gas and hot water supply is performed (that is, both the heat exchanger 502 and the gas hot water supply device 504 perform hot water supply). Specifically, the control section 600 performs the following processings.

[0100]That is, first, the control section 600 calculates recovery heat:Hrec [kcal/s] from the map beforehand stored in ROM (not shown) based on the output current Ifc of the fuel cell 200 computed in the above-mentioned step S104 [A], as shown in a formula (18).

[0101]

Hrec[kcal/s]=MAP(Ifc) (18)

[0102]Here, Hrec is the recovery heat at the time of collecting the waste heat thrown away into cooling water by the fuel cell 200 by the heat exchanger 502. This recovery heat Hrec has correlation as indicated to be the output current Ifc of the fuel cell 200 [A] to drawing 4, for example.

[0103]Next, the control section 600 acquires quantity-of-heat:Hb [kcal/s] required for hot water supply, and computes flow:Fbc [mol/s] of town gas required for the hot water supply in the case of providing this quantity-of-heat Hb [kcal/s] by use of town gas, and use of the waste heat from the fuel cell 200 according to a formula (19).

[0104]However, since quantity-of-heat Hb required for hot water supply can be altogether provided with the quantity of heat Hrec collected from the waste heat of the fuel cell 200 in Hb<=Hrec, it is not necessary to use town gas for hot water supply. Therefore, the flow Fbc of town gas required for hot water supply is set to zero.

[0105]On the contrary, in Hb>Hrec, quantity-of-heat Hb required for hot water supply needs to compensate quantity of heat using **** and the town gas which run short by the quantity of heat Hrec collected from the waste heat of the fuel cell 200. Therefore, the flow Fbc of town gas required for hot water supply follows a formula (19).

[0106]

Fbc[mol/s] =Kh2fx(Hb-Hrec) (19)

[0107]Here, Kh2f is a conversion factor which comprises the combustion heat of methane which is the main ingredients of town gas, the heat exchange effectiveness of the gas hot water supply device 504, etc. as it was mentioned above.

[0108]In this way, to every sampling time:DT (= 1 sec), the control section 600 computes flow:Fbci [mol/s] of town gas required for hot water supply, according to a formula (20), is integrating with 60 samples and computes operating gas volume (only hot water supply):Vbc [m^3] for the past 1 minute.

[0109]

Vbc[m^3] =Km2 vxsigma (FbcixDT) (20)

[0110]Here, Km2v is a coefficient for changing the number of mols into the capacity of a normal condition (20 **, 1 atmosphere) as it mentioned above.

[0111]Next, the control section 600 computed cost:Cgbc in the case of performing hot water supply [circle] for the past 1 minute according to the formula (21) using the waste heat from town gas and the fuel cell 200 from the operating gas volume [it computed] (only hot water supply) [m^3] Vbc during this past minute.

[0112]

Cgbc [circle] =Kg1+Kg2xVbc (21)

[0113]Kg1 is a constant which is equivalent to the basic charge of the gas for the past 1 minute as mentioned above here, and Kg2 is a coefficient equivalent to the commodity charge unit price of gas.

[0114]In this way, it can ask for the cost at the time of assuming that hot water supply is performed by using the waste heat from the fuel cell 200 at least.

[0115]When hot water supply is carried out in the home as above, the following two usage patterns can be considered. That is, the 1st is the gestalt which covers the power consumption in the household electric load 400 by purchase from an electric power company, and performs hot water supply for [500] hot water supply by using only town gas, i.e., a gestalt in case there is no cogeneration. The 2nd is the gestalt which covers the power consumption in the household electric load 400 by the home generation of electricity by the fuel cell 200, and performs hot water supply for [500] hot water supply by using the waste heat from the fuel cell 200 at least, i.e., a gestalt in case there is cogeneration.

[0116]The cost (cost for the past 1 minute: Ce [circle]) at the time of assuming that the cost which starts in the case of the former usage pattern is provided by purchase from an electric power company for which it asked at Step S102, It is peace Ce+Cgb [circle] of the cost (cost for for the past 1 minute: Cgb [circle]) at the time of assuming that hot water supply is performed only using the town gas for which it asked at Step S114, and **. On the other hand, the cost which starts in the case of the latter usage pattern, The cost (cost for the past 1 minute: Cg [circle]) at the time of assuming that meals are provided by the home generation of electricity by the fuel cell 200 for which it asked at Step S104, It is peace Cg+Cgbc [circle] of the cost (cost for for the past 1 minute: Cgbc [circle]) at the time of assuming that hot water supply is performed using at least the waste heat from the fuel cell 200 for which it asked at Step S116, and **.

[0117]Then, the cost (cost for the past 1 minute: Ce+Cgb [circle]) which the control section 600 requires in the case of the former usage pattern, The cost (cost for the past 1 minute: Cg+Cgbc [circle]) which starts in the case of the latter usage pattern, The direction of cost Cg+Cgbc [circle] which compares and starts in the case of the latter usage patterns (home generation of electricity etc.), In being cheaper than cost Ce+Cgb [circle] which starts in the case of the former usage patterns (purchase from an electric power company, etc.), According to a formula (22), the relay flag RLYa corresponding to the relay switch A by the side of a fuel cell is turned ON, and the relay flag RLYb corresponding to the relay switch B by the side of outside line is turned OFF (Step S120).

[0118]IF Ce+Cgb>=Cg+Cgbc THEN RLYa=ON, RLYb=OFF (22)

[0119]The direction of cost Ce+Cgb [circle] which starts in the case of the former usage patterns (purchase from an electric power company, etc.) on the contrary, In being cheaper than cost Cg+Cgbc [circle] which starts in the case of the latter usage patterns (home generation of electricity etc.), According to a formula (23), the relay flag RLYa corresponding to the relay switch A by the side of a fuel cell is turned OFF, and the relay flag RLYb corresponding to the relay switch B by the side of outside line is turned ON (Step S122).

[0120]IF Ce+Cgb<Cg+Cgbc THEN RLYa=OFF,RLYb=ON(23)

[0121]However, at this time, the control section 600 does not switch the relay switches A and B.

[0122]The above is processing in case hot water supply is carried out in the home. If this processing is completed, it will progress to the processing after round A of drawing 3 following round A of drawing 2.

[0123]By the way, generally in a fuel cell system, there is the feature said that the response of a reformer is about 10 times as slow as that of a fuel cell. For this reason, for example, when carrying out the quick stop of the fuel cell system under operation, it is possible to carry out the quick stop of the drawing of the current from the fuel cell by an inverter, but. the fuel gas (hydrogen is included) generated in the meantime in order to maintain a reforming reaction for a while (several seconds), even if it carries out the quick stop of the supply of town gas in a reformer -- the inside of the atmosphere -- not discarding -- it did not obtain but there was a problem that energy efficiency will fall. On the contrary, when starting a stopped fuel cell system, even if it is going to generate electricity rapidly in a fuel cell, generation of the fuel gas in a reformer does not meet the deadline, but in this state. When it tried to have lengthened current from a fuel cell with an inverter, in the fuel cell, the polarization reaction appeared notably, and there was a problem that the output voltage of a fuel cell declined rapidly.

[0124]When the former problem switches the relay switch A to OFF from ON in the fuel cell system shown in drawing 1, when the latter problem switches the relay switch A to ON from OFF, it has a possibility of producing, respectively. Then, in this example, from the hydrogen quantity supplied to the fuel cell 200 as stated below. When computing the target current value of DC-AC inverter 302 and switching ON/OFF of the relay switch A, the target current value is used and it is made to perform cooperative control of DC-AC inverter 302. Hereafter, processing is explained to the concrete target of the control section 600.

[0125]That is, in the control routine shown in drawing 3, the control section 600 calculates the target current value of DC-AC inverter 302 first from the hydrogen quantity supplied to the fuel cell 200 (Step S124). Specifically, it becomes as follows.

[0126]First, from the detection result of the flow rate sensor 60, the control section 600 acquires measurement value:Fk [mol/s] of a town gas flow, and computes point estimate:Fhest [mol/s] of the hydrogen quantity supplied to the fuel cell 200 from the value using a reformer model. For example, supposing it expresses the reformer 100 with "following delay + 1 Dead time" system, the above-mentioned point estimate Fhest [mol/s] will become like a formula (24).

[0127]Fhest[mol/s] =exp(taukxS)/(TkxS+1) xFk (24)

[0128]Here, tauk and Tk are the dead time of the reformer 100, and a damping time constant, and S is a Laplace operator.

[0129]Although a formula (24) is what is called open loop presumption, in order to raise accuracy further, a Kalman filter etc. are used for it and it is good also as closed-loop presumption.

[0130]Next, in [this hydrogen quantity is supplied to the fuel cell 200 to the point estimate Fhest of the hydrogen quantity which the control section 600 computed [mol/s], and] the fuel cell 200, The hydrogen quantity is consumed the neither more nor less, the output current Ifc of the fuel cell 200 [A] when power generation is performed appropriately is searched for by counting a formula (8) backward, and the value is set to target current value:Iinv [A] of DC-AC inverter 302. That is, by DC-AC inverter 302, from the fuel cell 200, the target current value Iinv [above-mentioned hydrogen quantity Fhest[mol/s supplied with the fuel cell 200 by lengthening a part for A] and current] will be consumed the neither more nor less, and will be generated.

[0131]Specifically, the target current value Iinv of DC-AC inverter 302 [A] becomes like a formula (25).

[0132]

Iinv[A] =Fhestx(2xF)/Kfch (25)

[0133]Next, the control section 600 checks the ON/OFF state of the relay switches A and B, and the ON/OFF state of the relay flags RLYa and RLYb, respectively (Step S126). And if the relay switch A is ON and the relay flag RLYa is OFF as a result of a check (Step S128), the change processing to OFF from ON of the relay switch A will be permitted (Step S130), and it will escape from the control routine shown in drawing 3. If the relay switch A is OFF and the relay flag RLYa is ON (Step S132), the change processing to ON from OFF of the relay switch A will be permitted (Step S132), and it will escape from the control routine shown in drawing 3. In other than the above, it escapes from the control routine shown in drawing 3 as it is. Above, explanation of the control routine shown in drawing 3 is ended.

[0134]Next, drawing 5 is a flow chart which shows the procedure of the change processing to OFF from ON of the relay switch A.

[0135]When the change processing to OFF from ON of the relay switch A is permitted, the control section 600 starts the change processing shown in drawing 5 in parallel to the control routine shown in drawing 2 and drawing 3 which are repeated for every fixed time. First, the control section 600 controls the flow control valve 58, and suspends supply of the town gas to the reformer 100 (Step S202). Next, the control section 600 performs cooperative control of DC-AC inverter 302 based on the target current value Iinv [A] computed, whenever processing of Step S124 of drawing 3 is repeated (Step S204). That is, the control section 600 controls DC-AC inverter 302 to pull out the current which is equivalent to the target current value Iinv [A] from the fuel cell 200 as output current. And the relay switch B is switched to ON from OFF at the same time the control section 600 ends the cooperative control of DC-AC inverter 302 after specified time elapse from the supply interruption of town gas and it switches the relay switch A to OFF from ON (Step S206). In this way, the change processing to OFF from ON of the relay switch A is ended.

[0136]The timing chart in this case is shown in drawing 6. In drawing 6, (a) shows supply/halt condition of the town gas to the reformer 100, (b) shows the ON/OFF state of the relay switch A, and (c) shows the target current value Iinv of DC-AC inverter 302. A horizontal axis is time.

[0137]As shown in drawing 6, after suspending supply of the town gas to the reformer 100, cooperative control of DC-AC inverter 302 is performed according to the target current value Iinv, and the relay switch A is switched from ON at OFF after the specified time elapse whose target current value Iinv decreased.

[0138]Thus, by performing cooperative control of DC-AC inverter 302 at the time of the change to OFF from ON of the relay switch A, In the reformer 100 after suspending supply of the town gas to the reformer 100, Energy efficiency can be raised without discarding fuel gas in the atmosphere, since the fuel gas will be consumed the neither more nor less in the fuel cell 200 and power generation operation will be gradually ended, even if a reforming reaction continues for a while and fuel gas is generated.

[0139]Next, drawing 7 is a flow chart which shows the procedure of the change processing to ON from OFF of the relay switch A.

[0140]On the contrary, when the change processing to ON from OFF of the relay switch A is permitted, the control section 600 starts the change processing shown in drawing 7 in parallel to the control routine shown in drawing 2 and drawing 3 which are repeated for every fixed time. First, the control section 600 controls the flow control valve 58, and starts supply of the town gas to the reformer 100 (Step S302). Next, the control section 600 performs cooperative control of same DC-AC inverter 302 with having mentioned above based on the target current value Iinv [A] computed, whenever processing of Step S124 of drawing 3 is repeated (Step S304). And the relay switch B is switched to OFF from ON at the same time the control section 600 will end the cooperative control of DC-AC inverter 302 and it will switch the relay switch A to ON from OFF, if specified time elapse is carried out from the supply start of town gas (Step S306). In this way, the change processing to ON from OFF of the relay switch A is ended.

[0141]The timing chart in this case is shown in drawing 8. In drawing 8, (a) shows supply/halt condition of the town gas to the reformer 100, (b) shows the ON/OFF state of the relay switch A, and (c) shows the target current value Iinv of DC-AC inverter 302. A horizontal axis is time.

[0142]As shown in drawing 8, after suspending the start of the town gas to the reformer 100, cooperative control of DC-AC inverter 302 is performed according to the target current value Iinv, and the relay switch A is switched to ON from OFF after the specified time elapse in which the target current value Iinv has risen.

[0143]Thus, by performing cooperative control of DC-AC inverter 302 at the time of the change to ON from OFF of the relay switch A, It can bring close to a stationary state gradually after the supply start of the town gas to the reformer 100, without producing a polarization reaction, since only a part to have been generated with the reformer 100 consumes fuel gas the neither more nor less in the fuel cell 200 and performs power generation operation.

[0144]As explained above, since according to this example the electric power from the fuel cell 200 and the electric power from an electric power company is switched and the supply source of electric power can be chosen so that total cost may become cheaper every moment, it becomes possible to hold down a total running cost the optimal. Since the change of such electric power is performed automatically, without caring about a change, the user can use electric power and can realize work saving. Since cogeneration is also positively taken into consideration, the energy efficiency of the whole system can be raised, such as using the waste heat from the fuel cell 200 for hot water supply.

[0145]In the range which is not restricted to the above-mentioned example or embodiment and does not deviate from the gist, this invention can be carried out in various modes.

[0146]D. Modification : in the example of which the D-1. modification 1:above was done, when having switched the relay switches A and B and one relay switch was turned on, the control section 600 had switched the relay switch of another side so that it might turn off. However, when the relay switch A supplies the electric power obtained by the home generation of electricity by the fuel cell 200 by ON to the household electric load 400, When rapid increase of electric load takes place and generation of the fuel gas in the reformer 100 does not fulfill demand (transient worst case), transitionally, in response to supply of electric power, an insufficiency is compensated via outside line from an electric power company, and there is necessity. Then, the modification which added such control is explained.

[0147]In this modification, the control section 600 turns on the relay switch B if needed, when the relay switch A is ON.

[0148]Drawing 9 is a flow chart which shows the principal part of the control procedure of the control section 600 in this modification. The processing shown in drawing 9 is added to the tail end of the control routine of drawing 2 and drawing 3.

[0149]The result which the control section 600 checked at Step S126 of drawing 3 as shown in drawing 9, The current Ifc which should be outputted from the fuel cell 200 in order to cover the power consumption in the household electric load 400 computed in Step S104 of drawing 2 when the relay switch A is ON (Step S136) [A], i.e., desired value, The output current (target current value of DC-AC inverter 302) [A] Iinv of the fuel cell 200 computed in Step S124 of drawing 3 when the supplied hydrogen quantity is consumed the neither more nor less and power generation is performed appropriately, i.e., a realizable value. A ** difference is searched for and it is judged whether the difference (Ifc-Iinv) is larger than the threshold Kth (Step S138). Here, Kth is a threshold for permitting ON of the relay switch B, when the relay switch A is ON.

[0150]And when a difference (Ifc-Iinv) is larger than the threshold Kth, namely, when the desired value Ifc of the output current of the fuel cell 200 is too large compared with the realizable value Iinv as a result of a judgment, electric load increases rapidly, Judging that generation of the fuel gas in the reformer 100 has not fulfilled demand to it (getting it blocked transient worst case), the control section 600 turns ON the relay switch B (Step S140).

[0151]In being other, the control section 600 escapes from the control routine of drawing 2 and drawing 3 as it is without doing anything.

[0152]Even when rapid increase of electric load takes place by performing such control and generation of the fuel gas in the reformer 100 does not fulfill demand (transient worst case), in response to supply of electric power, an insufficiency can be compensated from an electric power company. Stable operation can be secured even when the electric generating capacity by the fuel cell 200 becomes insufficient transitionally at the time of the cooperative control performed at Step S204 of drawing 5.

[0153]Modification 2 : D-2. In the above-mentioned example, In Step S124 of drawing 3, when calculating the target current value Iinv of DC-AC inverter 302 [A], presumed the hydrogen quantity supplied to the fuel cell 200 from the measurement value Fk of the town gas flow which is a detection result of the flow rate sensor 60, but. Inside of the gas passageway from the reformer 100 to the fuel cell 200 (preferably, a desired sensor is formed in the fuel gas of the fuel cell 200, and it may be made to carry out direct measuring of the hydrogen quantity supplied to the fuel cell 200.) In that case, the control section 600 calculates the target current value Iinv of DC-AC inverter 302 [A] from the measurement value:Fhmes [mol/s] according to a formula (26).

[0154]

Iinv[A] =Fhmesx(2xF)/Kfch (26)

[0155]By using such a method, it is more accurate and the target current value Iinv of DC-AC inverter 302 [A] can be calculated.

[0156]D-3. Other modifications : in the above-mentioned example, although the hot-water-supply object was mentioned as an example as heat load, in the case of a bath etc., hot water supply is performed by the heat exchanger 502 and the gas hot water supply device 504, and also when boiling again with a gas rice cooker, it thinks. Also in this case, naturally this invention is applicable.

[0157]As fuel supplied to the fuel cell device 700, petroleum fuel, such as alcohol which is commercial gas, such as ethanol, methanol, etc. besides town gas or propane, gasoline, kerosene, aldehyde, ether, etc. are contained.

[0158]It cannot be overemphasized that the fuel cell system of this invention is available also as objects for enterprises, such as not only home use but an office and a convenience store.

[Translation done.]

* NOTICES *

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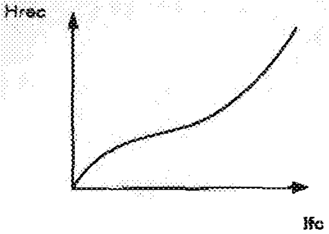
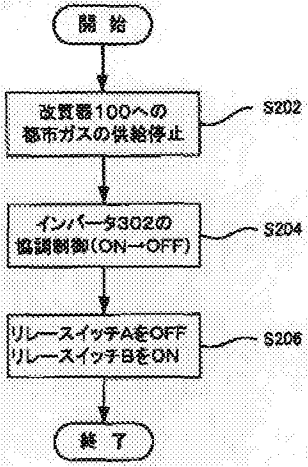
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

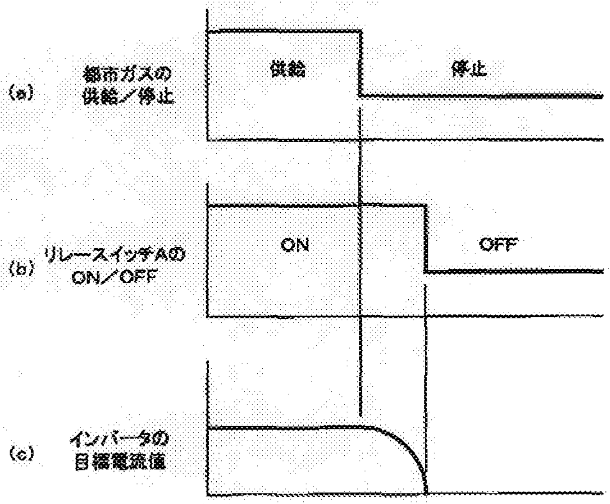
[Drawing 4]



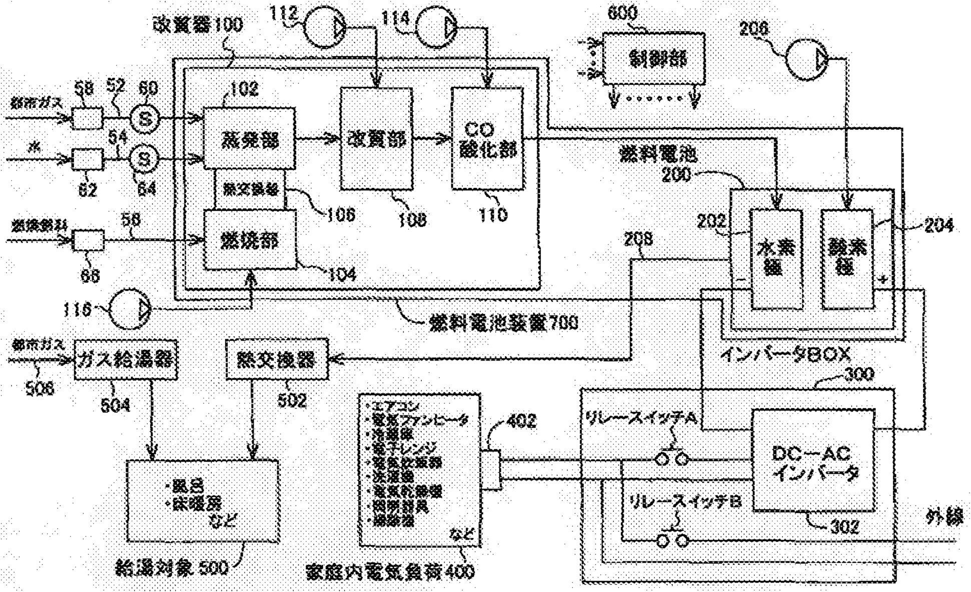
[Drawing 5]


開 始
改質器100への
都市ガスの供給停止
S202
インバータ302の
協調制御(ON→OFF)
S204
リレースイッチAをOFF
リレースイッチBをON
S206
終 了

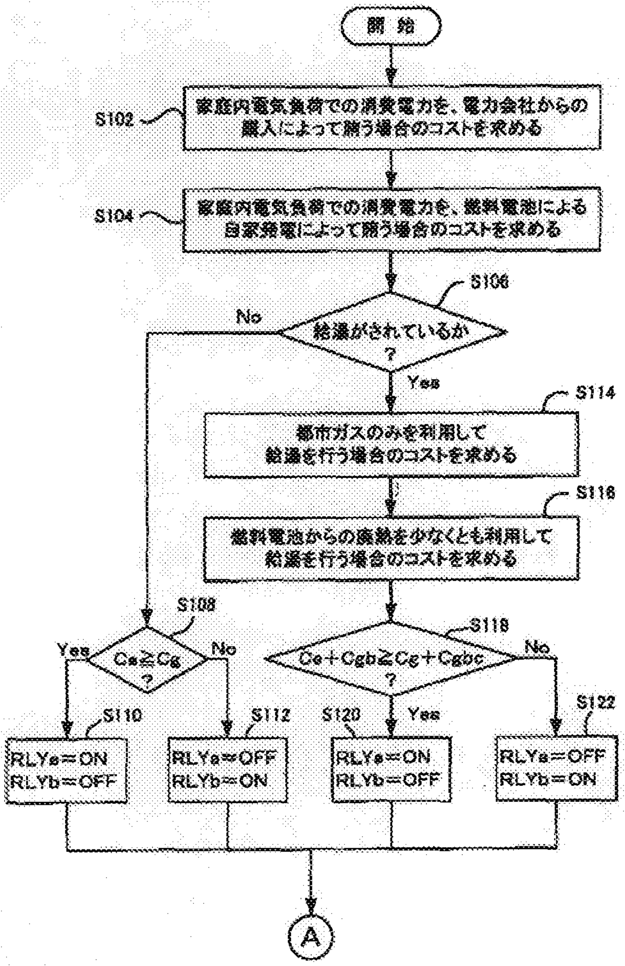
[Drawing 6]



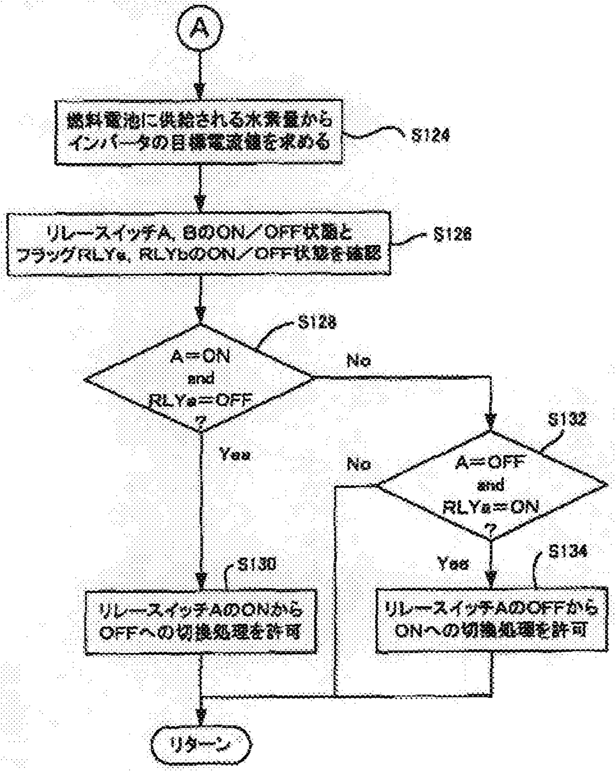
[Drawing 1]


改質器100
112
114
600
制御部
206
都市ガス
58
52
60
S
102
蒸発部
改質部
CO酸化部
水
54
S
62
64
熱交換器
106
108
110
燃料電池
200
燃焼部
58
66
104
208
202
水素極
酸素極
204
−
+
116
燃料電池装置700
都市ガス
ガス給湯器
506
504
熱交換器
502
インバータBOX
300
・エアコン
・電気ファンヒータ
・冷蔵庫
・電子レンジ
・電気炊飯器
・洗濯機
・電気乾燥機
・照明器具
・掃除機
など
402
リレースイッチA
DC−AC インバータ
リレースイッチB
302
外線
・風呂
・床暖房
など
給湯対象500
家庭内電気負荷400

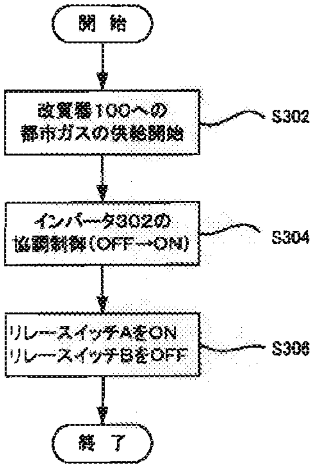
[Drawing 2]


開 始
S102
家庭内電気負荷での消費電力を、電力会社からの購入によって賄う場合のコストを求める
S104
家庭内電気負荷での消費電力を、燃料電池による自家発電によって賄う場合のコストを求める
S106
給湯がされているか？
No
Yes
S114
都市ガスのみを利用して給湯を行う場合のコストを求める
S116
燃料電池からの廃熱を少なくとも利用して給湯を行う場合のコストを求める
S108
Yes
Ce≧Cg ?
No
S118
Ce+Cgb≧Cg+Cgbc ?
No
Yes
S110
RLYa=ON RLYb=OFF
S112
RLYa=OFF RLYb=ON
S120
RLYa=ON RLYb=OFF
S122
RLYa=OFF RLYb=ON
A

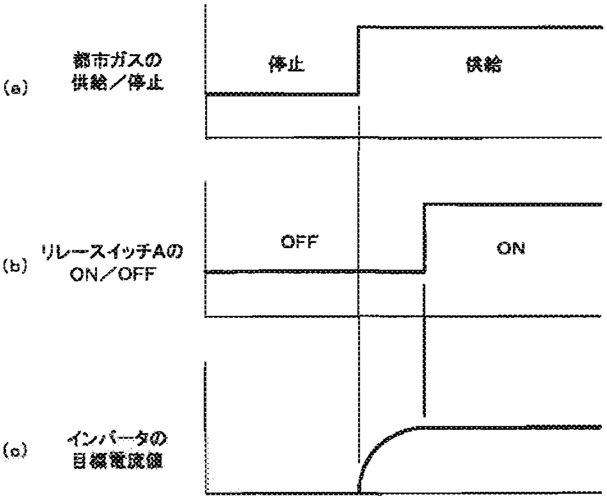
[Drawing 3]


A
燃料電池に供給される水素量からインバータの目標電流値を求める
S124
リレースイッチA, BのON／OFF状態とフラッグRLYa, RLYbのON／OFF状態を確認
S126
S128
A=ON and RLYa=OFF ?
No
Yes
S132
A=OFF and RLYa=ON ?
No
Yes
S130
リレースイッチAのONからOFFへの切換処理を許可
S134
リレースイッチAのOFFからONへの切換処理を許可
リターン

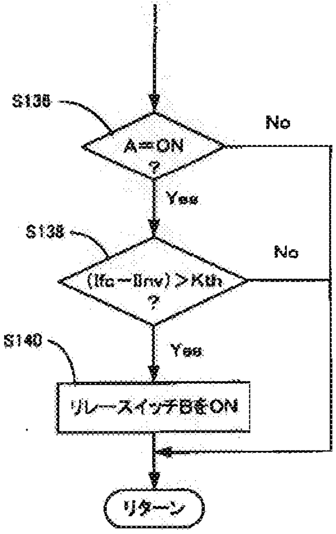
[Drawing 7]


開 始
改質器100への
都市ガスの供給開始
S302
インバータ302の
協調制御（OFF→ON）
S304
リレースイッチAをON
リレースイッチBをOFF
S306
終 了

[Drawing 8]



[Drawing 9]


S136
A=ON
?
No
Yes
S138
(Ifc−Iinv)>Kth
?
No
S140
Yes
リレースイッチBをON
リターン

[Translation done.]